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(54) **Milling apparatus for widening drill-holes and perforations**

(57) Apparatus for milling a widening within a drill-hole comprises an interior body 2 in which is eccentrically mounted the shaft 3 of a milling cutter 4 and which in turn is eccentrically mounted in an exterior body 1. By rotating the bodies 1 and 2 relatively to one another, the cutter 4 may be located concentrically for insertion into or removal from a drill-hole or located eccentrically of the drill-hole to cut into the wall thereof and produce the desired widening.

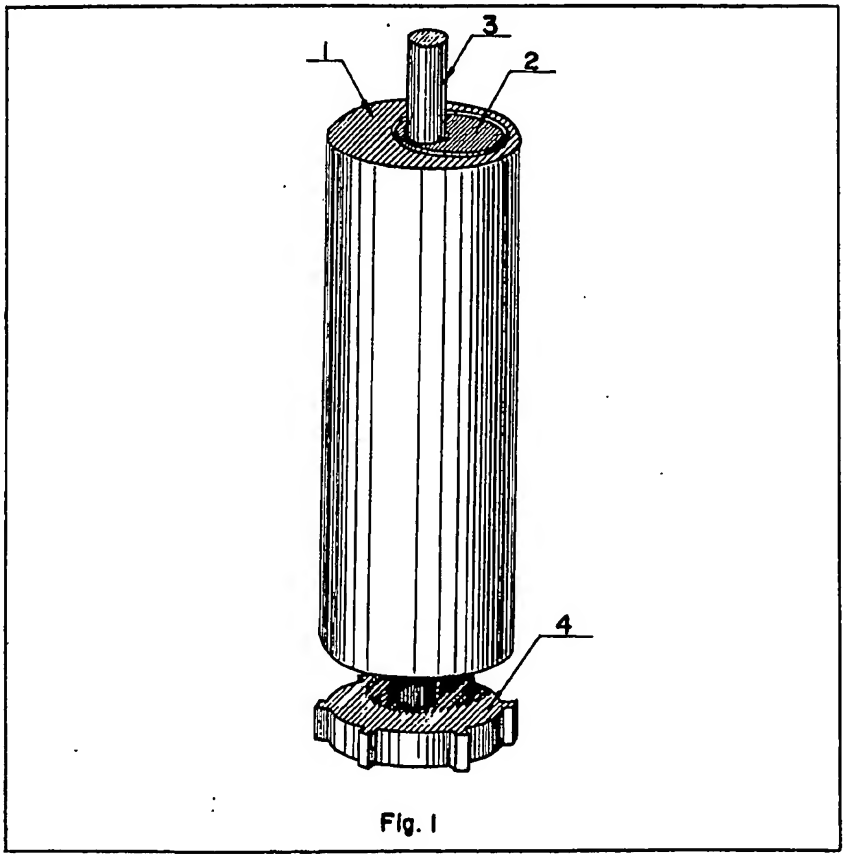

Fig. 1

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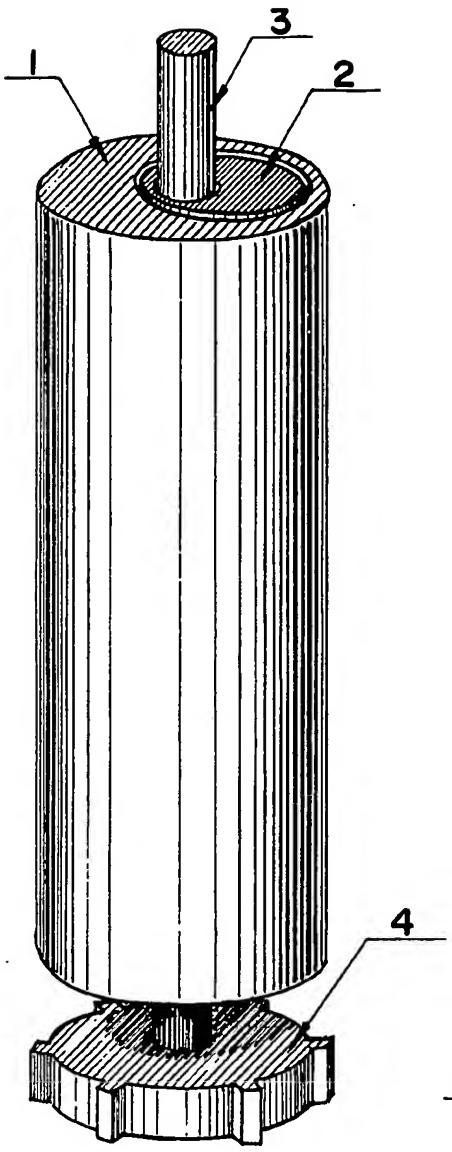

Fig. 1

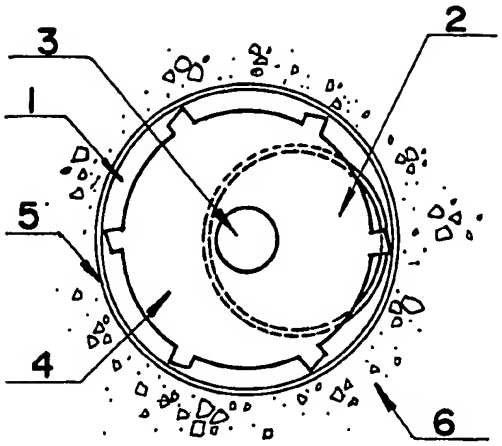

Fig. 2

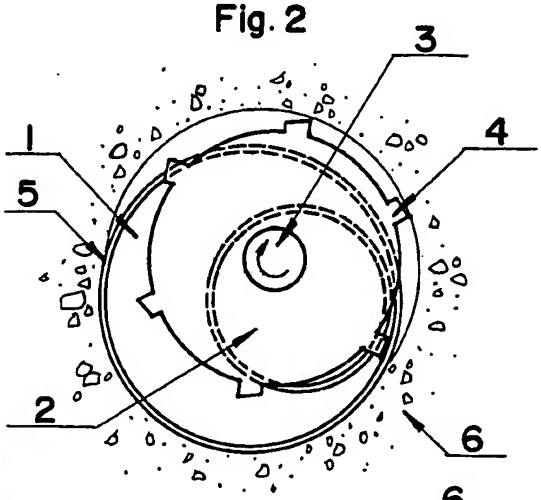

Fig. 3

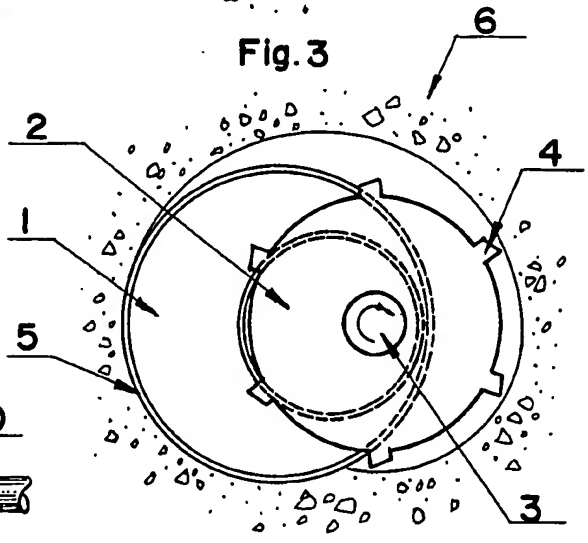

Fig. 4

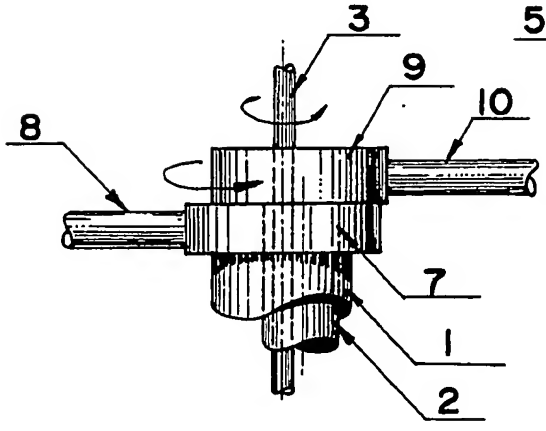

Fig. 5

SPECIFICATION

Milling apparatus for widening drill-holes and perforations

This invention is concerned with apparatus for widening drillholes and perforations by milling.

In this specification, "drill-hole" means a narrow hole made with a drilling machine or similar instrument.

The term "drill-hole with widening" means a drill-hole which at a certain depth has a widened zone, at which the transverse dimension of the hole is greater than the general diameter of the original drill-hole, which was previously made by other conventional means such as drilling or perforating.

This type of "drill-hole with widening" has a wide application for industrial purposes, and especially to make anchorages within the hole. Once a bolt or other anchoring element having an expansionable element is introduced in the drill-hole, and expanded into the widened zone, the bolt remains rigidly anchored to the body in which the drill-hole was made.

This type of anchorage, which ensures absolute anchorage security, has not hitherto been possible since no process existed for the widening of drill-holes, which can now be done by apparatus according to the present invention.

Apparatus according to the present invention comprises the followint three fundamental pieces:

(a) An elongated body, hereinafter denominated "exterior body", provided with an eccentric longitudinal perforation in which is installed;

(b) an elongated body, hereinafter denominated "interior body" which in turn is provided with another eccentric longitudinal perforation, in which a shaft is installed; and

(c) one or more milling cutters (blades or similar cutting elements), fixed on the end of a sald shaft.

In other words, the mill shaft, carrying milling or cutting elements, is mounted in the eccentric perforation in the interior body, penetrating it longitudinally, and the interior body is in turn mounted in the eccentric perforation in the exterior body.

These three pieces (exterior body, interior body and mill shaft) are of such length that on introducing the apparatus through the length of a previously made drill hole or perforation the mill or mills can be located at the depth of the drill-hole at which it is desired to make the widening, and the apparatus protrudes sufficiently from the drill-hole so that the rotation of the pieces which determine the operation of the apparatus, can be made.

Each of the three pieces of the apparatus can rotate, with respect to the piece in which it is installed, within the perforation where it is mounted. In other words, the mill shaft can rotate with respect to the interior body, and the latter, in turn, with respect to th exterior body which is rotatable in the drill-hole.

Due to the eccentric assemblies existing in the two bodies of the apparatus, rotation of one of them with respect to the other determines the transversal displacement of the milling cutter, in such manner that the latter is locat d in its most central position with respect to the exterior body when the eccentricities of the perforations of both bodies are oriented in opposite directions and reaches its most uncentered position when such eccentricities are oriented in the same direction. Therefore, on situating the rwo bodies so that the eccentricities of their perforations are oriented in opposite directions, the mill projects transversely from the exterior body by a minimum amount (or does not project at all if its diameter is of suitable size), which enables the apparatus to be introduced through the length of the drill-hole or perforation until the milling cutter or cutters is situated at the depth at which the drill-hole widening is desired.

Once the apparatus has been introduced down to the depth required, the milling cutter is turned (manually or by means of an electric motot or other procedure), and the interior body is rotated with respect to the exterior body, thus changing the relative orientation of the eccentricities of their perforations. The milling cutter is thus transverselly moved towards the exterior of the apparatus and since the exterior body is confined within the drill-hole, the milling cutter advances against the wall the drill-hole and produces the widening of the drill-hole. The maximym penetration of the milling cutter (and thus the maximym dimension of the widening), it is necessary to turn the interior body 180 degrees with respect to the exterior body from the position in which it was when the apparatus was introduced in the drill-hole.

To extend the widening over the entire perimeter of the drill-hole, the interior and exterior bodies ar maintained in this same relative position (with the eccentricities of their perforations oriented in the same direction), and together give a complete rotation, so that the milling cutter transverses the drill-hole perimeter. Once the widening operation is completed, the exterior body is turned 180 degrees with respect to the interior body (or vice-versa), so that the eccentricities of the perforations of both bodies are again oriented in opposite directions, and the milling cutter is moved towards the center of the exterior body, thus enabling extraction of the apparatus from the drill-hole.

Other parts of the invention are embodied in the preferred form which will now be described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a perspective view of one form of apparatus embodying the invention;

Figure 2 is a plan view showing the milling cutter in the retracted position;

Figure 3 is a view similar to Figure 2 showing the milling cutter in a partially extended position;

Figure 4 is a view similar to Figure 2 showing the milling cutters fully extended; and

Figure 5 is a side view of part of the apparatus.

In Figure1, an exterior body (1) has an eccentric perforation in which an interior body (2) is mounted. The interior b dy (2) in turn has an eccentric perforation in which is mounted a mill shaft (3), a milling cutter (4) with which the widening is performed, is attached to the shaft (3).

Figure 2 shows the plan view of a drill-hole or perforation (5) in the body (6) into which the apparatus is introduced. The eccentricities of the perforations in the exterior body (1) and in the interior body (2), are oriented in opposite directions, so that the mill shaft (3) is concentric with the exterior body (1) and the apparatus can be introduced into the hole.

In Figure 3, the interior body (2) has been turned, while maintaining the exterior body (2) stationary. The mill shaft (3) is thus displaced transversely and the mill (4) advanced against the wall of the drill-hole (5). widening of the drill-hole thus results from the rotation of the mill shaft by conventional means (rotating machine, manually or other means).

In Figure 4, the interior body (2) has been turned 180 degrees relative to its position in Figure 2, so that the eccentricities of the perforations existing in the exterior body (1) and in the interior body (2) are oriented in the same direction, producing the maximum displacement of the milling cutter (4) towards the outside of the exterior body (6), and consequently the maximum penetration of the milling cutter (4) into the wall of the drill-hole (5), and causing the maximum dimension of the widening of the drill-hole. If it is wished to make a widening over the entire drill-hole perimeter, it is only necessary to maintain the exterior body (1) and the interior body (2) in the same position as in Figure 4, and jointly rotate both bodies through a complete rotation.

Figure 5 shows means for controlling the positions of the eccentricities. A head (7) with a handle (8) is attached to the exterior body (1), and another rotating head (9) with a driving handle (10) is attached to the interior body (2) where the shaft (3) of the milling cutter (4) is mounted. The shaft (3) to which a suitable motor or transmission device is coupled is the power source of the apparatus.

In Figures 3 and 4, the widening of the drill-hole is obtained by fixedly maintaining the exterior body (1) and turning the interior body (2), but it is possible to proceed the other way around, that is, by maintaining fixed the interior body (2) and turning the exterior body (1). It is also possible to make turns in both bodies simultaneously in such manner that the orientation of the eccentricities of their perforations varies.

It will be understood that th invention is not restricted to the details of the preferred form described by way of example, which can be modified without departure from the scope of the acc mpanying claims.

CLAIMS

1. Milling apparatus for widening drill holes and perforations comprising an exterior elongated body provided with an eccentric longitudinal perforation, an interior elongated body mounted in said perforation and in turn provided with another eccentric longitudinal perforation, a shaft mounted in said other perforation and a cutting element mounted on said shaft and transversely located at the end thereof, said two elongated bodies and said shaft each rotatable independently of the others, so that the operative effect of the apparatus is determined by the rotation of the mills and the rotation of one of the bodies with respect to the other.

2. Apparatus as claimed in Claim 1, in which both the elongated bodies and the shaft are of such length, that when the apparatus is introduced throughout the length of a pre-formed drill-hole or perforation, the cutting elements are located at the depth of the drill-hole at which the widening is to be made and the parts comprising the apparatus project from the drill-hole to allow rotation thereof.

3. Apparatus as claimed in either of the preceding claims, in which the exterior and interior bodies are so mounted eccentrically that rotation of one of them with respect to the other determines the transverse displacement of the cutting element, the cutting element being situated in its most centered position in relation to the exterior body when the eccentricities of the perforations of both bodies are oriented in opposite directions and the cutting element is at its most eccentric position in relation to the exterior body when the said eccentricities are oriented in the same direction, whereby on rotating one body in relation to the other in such manner that the eccentricities change their relative orientation, passing from an opposite direction to the same direction, the cutting element is advanced against the wall of the drill-hole and on rotation cuts the material of the drill-hole wall, to produce the widening, which may be extended to the entire perimeter of the drill-hole or to part thereof by maintaining the rotation of the cutter through one complete turn or through the angle corresponding to the extension of the desired widening, with the eccentricities of the perforations oriented in the same direction; and whereby on completion of the widening, the two bodies each can be rotated so that the eccentricities of the perforations are oriented in opposite directions, and the mill located in its most centered position in relation to the exterior body, to allow extraction of the apparatus for the whole length of the drill-hole.

4. Milling apparatus for widening drill-holes and perforations substantially as described with reference to the accompanying drawings.

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cutter 4 may be located concentrically for insertion into or removal from a drill- hole or located eccentrically of the drill-hole to cut into the wall thereof and produce the desired widening. <IMAGE>